REVTECH PROCESS SYSTEMS

Heat treatment technology

IAOM

July 26th – Branson, MO
August 8th – Brainerd, MN
September 12th – Moose Jaw, Saskatchewan
September 26th – Sandusky, OH

Celia Schlosser
<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Year</th>
<th>Number of cases</th>
<th>Isolated from product?</th>
<th>Outbreak location(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. coli O121, E. coli O26</td>
<td>2015–2016</td>
<td>63</td>
<td>yes</td>
<td>USA (24 states)</td>
</tr>
<tr>
<td>E. coli O121</td>
<td>2016–2017</td>
<td>30</td>
<td>yes</td>
<td>Canada (6 provinces)</td>
</tr>
<tr>
<td>E. coli O121</td>
<td>2017</td>
<td>6</td>
<td>yes</td>
<td>Canada (1 province: BC)</td>
</tr>
</tbody>
</table>

What is the common point?
### PRODUCT RECALLS

<table>
<thead>
<tr>
<th>Product</th>
<th>Pathogen</th>
<th>Year</th>
<th>Number of cases</th>
<th>Isolated from product?</th>
<th>Outbreak location(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Mills, Kansas City, MO</td>
<td>E. coli O121, E. coli O26</td>
<td>2015–2016</td>
<td>63</td>
<td>yes</td>
<td>USA (24 states)</td>
</tr>
<tr>
<td>Ardent Mills, Saskatoon, SK</td>
<td>E. coli O121</td>
<td>2016–2017</td>
<td>30</td>
<td>yes</td>
<td>Canada (6 provinces)</td>
</tr>
<tr>
<td>Rogers Foods, BC</td>
<td>E. coli O121</td>
<td>2017</td>
<td>6</td>
<td>yes</td>
<td>Canada (1 province: BC)</td>
</tr>
</tbody>
</table>

**Flour !**

**E. Coli !**
RISK ASSESSMENT PROCESS

1. Identify hazards
2. Assess risk
3. Control risk
4. Review controls

Modification of flour properties
Stabilization
Roasting
Pasteurization
WHY? IDENTIFY HAZARDS

- Is it ready to eat?
  - Yes
  - No (baked, cooked, fried)

- Has it been processed in a manner to eliminate pathogens?
  - Yes
  - No

- Acceptable? Validated?
  - Yes
  - No

- Risk

- Instructions given to the consumer?
  - Yes
  - No

- Is there a chance he will not follow exactly the cooking process?
  - Yes
  - No

- Risk

- Safe
2009, 77 people reported as sick, 30 states
Toll House Cookie Dough, Nestle
Was written not to eat before warm up
FDA found E. Coli in chocolate chip cookie dough
> 3.6 million packages recalled

Survey: 1,032 individuals in the United States
⇒ 58% of consumers have tasted refrigerated rough before baking

2010 : Nestle, USA decided using only heat-treated flours for refrigerated dough products
IS IT GOING TO EXTEND?

Against
Majority still going through kill step
Low moisture / water activity
Low level of microorganisms
Adverse effect on flour functionnality/quality
Cost

For
Product recalls
Can be exposed to pathogens in soil/water or from birds/animals
Can be impacted by wet harvest period / low harvest temperature
Increase for wholegrain foods (might reduce obesity, cardio vascular disease, diabetes...)
Can be eaten raw
Can be added to foods that will not be cooked (milkshakes, ice cream...)
HOW TO CONTROL THE RISK?

1. Wheat → Cleaning → Tempering → Milling

2. Wheat, 15% moisture → Heat treatment 1h, 60°C → Milling

3. APC: 2.43
   APC: 4.69

4. Chlorinated water
   Ozone
   Acetic / Lactic acid

5. Pasteurization
6. Modification of flour properties
7. Stabilization
8. Roasting


Dhillon et al., 2010
Galeas, 2014
HOW TO CONTROL THE RISK?

Higher contamination on the outer layers

Miskelly & al., 2010

Higher risk for whole wheat flour

Heat treat wheat kernels outer layers

Reduce microbiological load

Mill into flour
THE REVTECH TECHNOLOGY

- Stainless steel tube
- Support structure
- Product inlet
- Heat treated product outlet
- Pasteurization
- Modification of flour properties
- Stabilization
- Roasting

25-35%
THE REVTECH TECHNOLOGY

1. Transportation / mixing by vibrations
   Frequency: ~ 12 Hz
   Amplitude: ~ 4 mm
   Acceleration: ~ 4 g

2. Heating by direct contact with a hot surface
   High current
   Low voltage < 40V

3. Treatment in a confined atmosphere

Pasturization
Modification of flour properties
Stabilization
Roasting
THE REVTECH TECHNOLOGY

1. Pasteurization tower
2. Feeding system
3. Steam boiler
4. Electrical cabinet
5. Cooling system
6. Air filtering unit

Pasteurization
Modification of flour properties
Stabilization
Roasting
Flowrate
200 lbs/h to
-4,000 lbs/h (flour)
-11,000 lbs/h (grains)

Temperature
100 to 800°F

Residence time
1 to 40 mn

Atmosphere
air, steam, nitrogen...

with 2 to 4 independent heating zones

THE REVTECH TECHNOLOGY

Pasteurization
Modification of flour properties
Stabilization
Roasting
REVTECH RESULTS

Pasteurization

Modification of flour properties

Stabilization

Roasting

<table>
<thead>
<tr>
<th>Product</th>
<th>Conditions</th>
<th>Residence time</th>
<th>Steam</th>
<th>Tube temperature</th>
<th>TPC (cfu/g)</th>
<th>Enterobacteria (cfu/g)</th>
<th>Yeasts &amp; Molds (cfu/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat grains</td>
<td>Raw material</td>
<td></td>
<td></td>
<td></td>
<td>140 000</td>
<td>12 000</td>
<td>1 600</td>
</tr>
<tr>
<td></td>
<td>Revtech 1</td>
<td>5 min</td>
<td>10%</td>
<td>210°F</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
</tr>
<tr>
<td></td>
<td>Revtech 2</td>
<td></td>
<td></td>
<td>240°F</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
</tr>
<tr>
<td></td>
<td>Revtech 3</td>
<td></td>
<td></td>
<td>265°F</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
</tr>
</tbody>
</table>

Average of 3 Samples

5 log TPC < 10 for Enterobacteria / Yeasts & Molds
Safer wheat flour!
## REVTECH RESULTS

### Pasteurization

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</thead>
<tbody>
<tr>
<td>Wheat flour</td>
<td>Raw</td>
<td></td>
<td></td>
<td>2 000</td>
<td>510</td>
<td>320</td>
</tr>
<tr>
<td></td>
<td>Raw</td>
<td></td>
<td></td>
<td>5 000</td>
<td>1 500</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>Raw</td>
<td></td>
<td></td>
<td>2 300</td>
<td>120</td>
<td>150</td>
</tr>
<tr>
<td>Low temp</td>
<td>5 min</td>
<td>160°F</td>
<td></td>
<td>750</td>
<td>250</td>
<td>100</td>
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<tr>
<td></td>
<td>10 min</td>
<td></td>
<td></td>
<td>610</td>
<td>&lt; 40</td>
<td>&lt; 40</td>
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<tr>
<td></td>
<td>15 min</td>
<td></td>
<td></td>
<td>720</td>
<td>~ 40</td>
<td>&lt; 10</td>
</tr>
<tr>
<td>Medium temp</td>
<td>5 min</td>
<td>175°F</td>
<td></td>
<td>430</td>
<td>&lt; 40</td>
<td>~ 40</td>
</tr>
<tr>
<td></td>
<td>10 min</td>
<td></td>
<td></td>
<td>170</td>
<td>~ 40</td>
<td>&lt; 10</td>
</tr>
<tr>
<td></td>
<td>15 min</td>
<td></td>
<td></td>
<td>150</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
</tr>
<tr>
<td>High temp</td>
<td>5 min</td>
<td>190°F</td>
<td></td>
<td>&lt; 400</td>
<td>&lt; 10</td>
<td>&lt; 10</td>
</tr>
<tr>
<td></td>
<td>10 min</td>
<td></td>
<td></td>
<td>&lt; 40</td>
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Pasteurization works on wheat flour as well!

- But higher surface/volume ratio
- Higher contact with heat
- Might change flour properties
IMPROVING FLOUR PROPERTIES

Chlorinated / Bleached flours

1200-2500 ppm
pH : 4.6-5.1 (≈ 6.0 for untreated flour)

Texture: ◀️ Stickiness, ▶️ aeration
Color: ▶️ Crumb color, whiter flour
Starch: ◀️ Gelatinization T
Protein: ◀️ Gluten network strength

Carcinogenic effect
Must be labelled

High ratio cakes

in EU, Canada, UK, Japan and China

BANNED

Pasteurization
Modification of flour properties
Stabilization
Roasting
REVTECH RESULTS

Russo et al., 1970

1. Chlorinated flour
2. Untreated flour
3. Heat treated flour (Drum, 250°F)

Keppler, 2017

- Untreated flour
- Revtech 230°F, 10:45min
- Revtech 300°F, 9:50min

Pasteurization

Modification of flour properties

Stabilization

Roasting
REVTECH RESULTS

Flour dissolved in water, RVA tests

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Viscosity</th>
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<tbody>
<tr>
<td>Processing time</td>
<td></td>
</tr>
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Easier for granules to swell?

Instability of gluten network

Rheomixer tests

Keppler, 2017
WHAT ABOUT BRANS / GERMS?

- Pasteurization
- Modification of flour properties
- Stabilization
- Roasting

Raw brans / germs

Source of fibres

High enzyme activity: Lipase + Lipoxygenase

Short shelf life

About 250°F, 10 minutes

Enzyme inactivation

Shelf life
AND IF I WANT TO CHANGE COLOR/TASTE?

Temperature around 150 to 250°C / 300 to 480°F
Residence time around 10 to 20 mn

Wheat flour - 430°F, 0 – 3 – 6 – 9 – 15 – 30 mn

Milled wheat bran: 430°F, 0 – 3 – 6 – 12 – 18 – 24 mn

Wheat germs: 350°F, 0 – 6 – 9 – 12 – 21 mn
More than **120 units** installed around the world
CONCLUSION

More than **120 units** installed around the world
CONCLUSION

4 applications, 1 equipment

Great homogeneity

Only gentle vibrations (no auger, belt mixer)

Works for small pieces and powders

100 W/kg Pasteurization – 200 W/kg Roasting

Every machine can be validated to FDA standards
THANK YOU
Any question?

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• ConAgra Mills. The raw truth about consumer eating habits. Published online at www.conagramills.com/media/Food%20Habits-%20of%20American%20Consumers%20Final.pdf. ConAgra Mills, Omaha, NE, 2011
• SABILLÓN GALEAS, Luis E. Understanding the factors affecting microbiological quality of wheat milled products: from wheat fields to milling operations. 2014.
• ucfoodsafety.ucdavis.edu/files/271162.pdf